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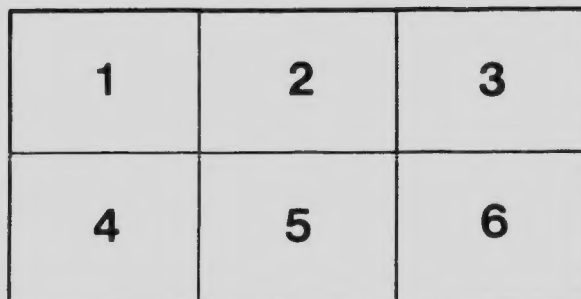
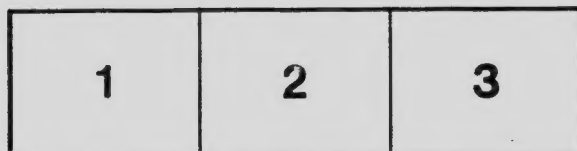
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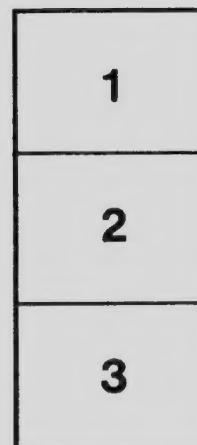
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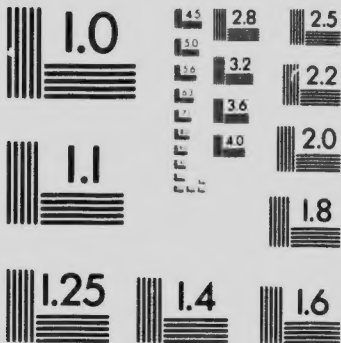
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THE PRODUCTION AND USE OF SEED GRAIN

BULLETIN No. S. 2

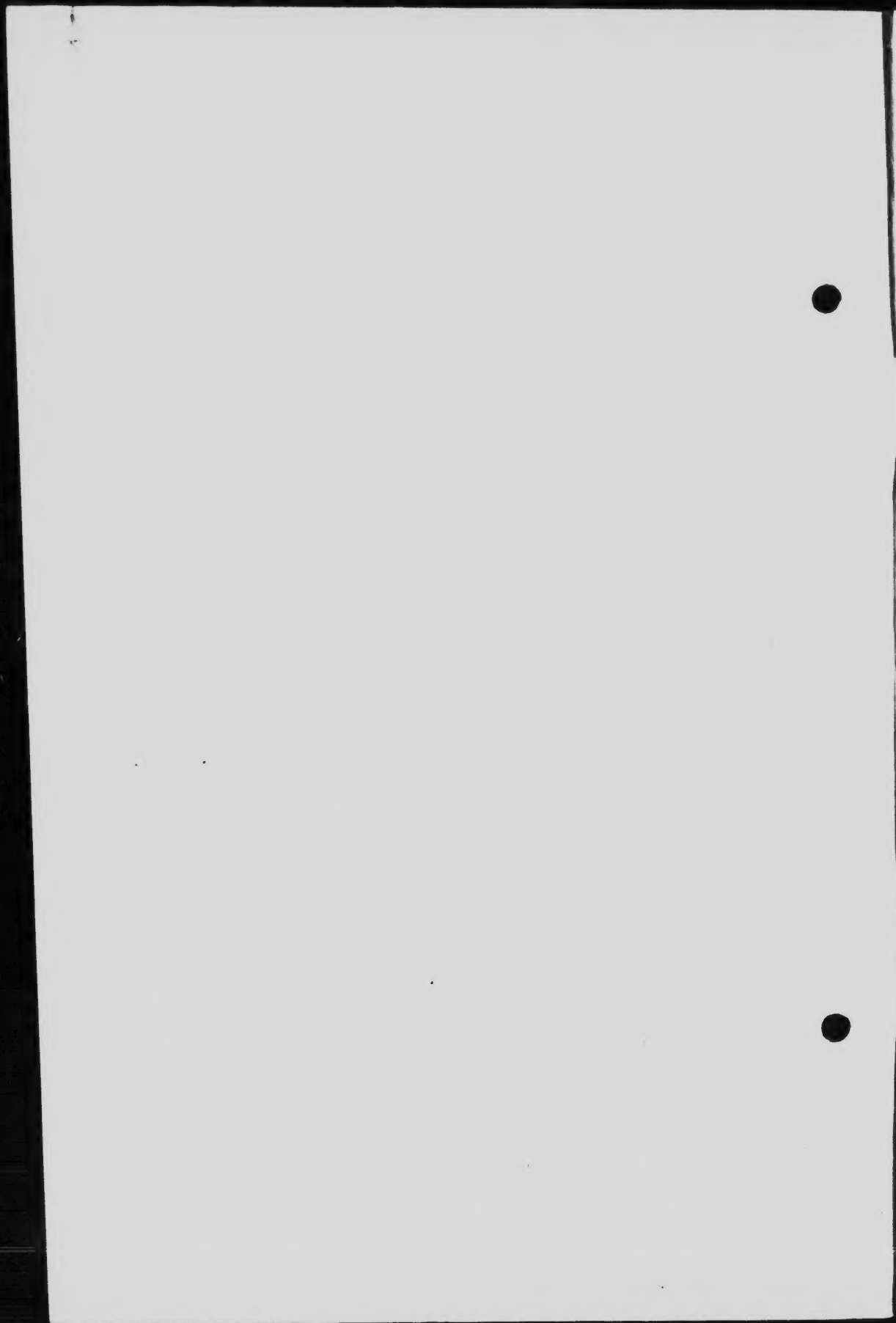
Published by direction of the Hon. SYDNEY A. FISHER, Minister of Agriculture, Ottawa, Ont.

NOVEMBER, 1905

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THE PRODUCTION AND USE OF SEED GRAIN

BY

JAMES MURRAY, B.S.A.

District Representative for the Provinces of Manitoba and Saskatchewan

SUMMARY OF CONTENTS

The seed—What it is; its functions—Why good seed is required—Varieties—Mixed varieties—Weeds—Seed of wild and cultivated oats (illustrated)—Size of seed—Ripe and immature seed—Frozen grain for seed—Seed from a rusted crop—The growing of seed—Seed and soil—The amount of seed per acre—Stacking *versus* stook threshing—Cleaning—Changing seed—Hand selection of seed—Treating for smut—Testing Seeds—Summary.



OFFICE OF THE SEED COMMISSIONER,

OTTAWA, November 15, 1905.

The Honourable,

The Minister of Agriculture.

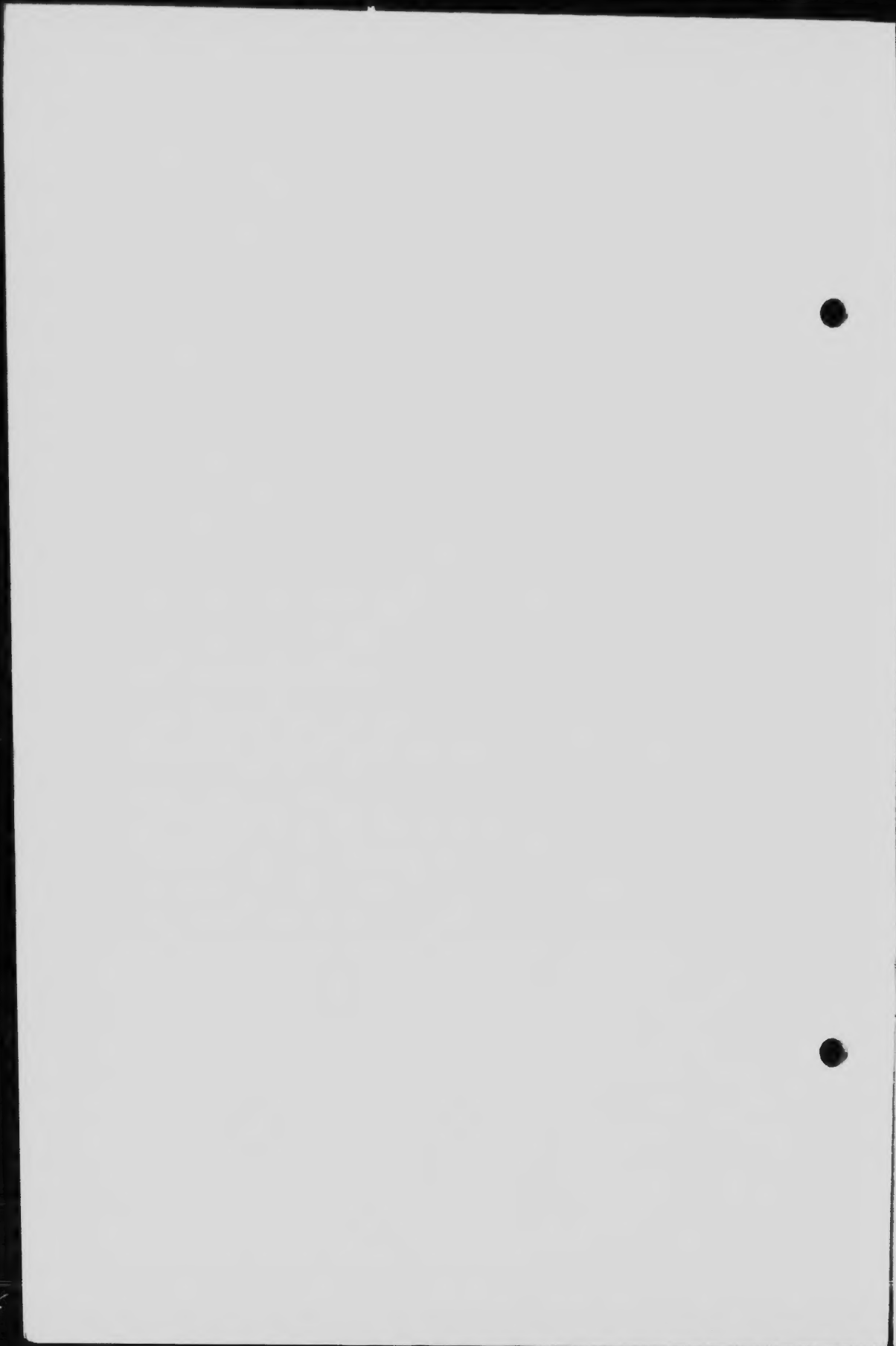
SIR,—I beg to transmit herewith a bulletin on the production and use of seed grain. The matter contained therein has been prepared by James Murray, B.S.A., who has been in the employ of this Branch since June, 1902. During the last two years Mr. Murray has given his whole attention to encouraging the production and use of high class seeds in the western provinces and has had a good opportunity to study the conditions and needs of farmers throughout the grain growing districts. I recommend that the bulletin be printed for general distribution throughout the provinces of Manitoba, Saskatchewan and Alberta.

I have the honour to be, sir,

Your obedient servant,

GEORGE H. CLARK,

Seed Commissioner.



THE PRODUCTION AND USE OF SEED GRAIN

The object of this bulletin is to present to those interested and engaged in grain growing in Western Canada, some facts regarding the growing and use of cereal seeds, in the hope that they may be found useful in promoting increased yield and improved quality in grain crops. No effort is made to cover all the various points to be observed in the production of grain in Manitoba, Saskatchewan, and Alberta. This would demand a volume. Of the information which this bulletin contains, much has already been given publicity in text books, and to a certain extent in bulletins. As thus presented, with no effort made to give those parts relating to seed any special prominence, they often appear fragmentary and disconnected. Unless brought together in some other form, various important facts regarding the value of seed, its production and handling, are never seen, or are quickly lost to view, by those to whom they would be most useful. While, therefore, the bulletin contains little that is new, it is hoped that the form of presentation may commend itself to those whom it reaches, and that useful service may thus be rendered in forwarding the greatest industry of the prairie provinces.

THE SEED—WHAT IT IS; ITS FUNCTION.

In grain, that which is called *seed*, is the ripened product of the plant, that which the plant lives to produce, and by means of which life is carried on from year to year. A seed consists essentially of two parts, the embryo and the endosperm. The embryo is a plantlet which develops under proper conditions into a plant similar to the one which produced it. The endosperm, the starchy part, consists of a store of food to nourish the embryo when growth starts. Under the proper conditions of heat, air, and moisture, the seed swells, the root bursts forth and strikes downward to gain support, and a tiny leaf also makes an appearance. While the embryo continues to grow, the amount of starch stored up gradually decreases as it is consumed by the young plant. It thus continues to feed until able to draw its nourishment from the soil. It will thus be seen that the strong early growth of the plant is dependent upon the supply of food material in the seed—but with this we shall deal more fully later.

The seed also is the means by which the qualities or characteristics possessed by the parent plant or its ancestors are transmitted to the plant which it produces. Plants transmit their characters from generation to generation, just as surely as do animals. A bearded variety will produce the bearded character in the progeny, an early ripening variety produces year after year plants that ripen early; a stiff strawed variety has this quality year after year. Heavy yielding plants and varieties in turn produce heavy yielders.

WHY GOOD SEED IS REQUIRED.

To intelligently consider the requisite qualities in good seed, and see clearly how essential it is that improvement be effected, we must understand the uses of the product. It is a matter of general knowledge that our highest grades of spring wheat **can** be used to produce a flour of unusual strength, but its value is due not so much to this fact, as to its usefulness for mixing wheats of a poorer quality in order to raise the standard of the resultant flour. 'The English miller does not want No. 1 hard for making a purely No. 1 hard wheat flour, but to mix with other sorts to make a standard flour of his own, and so long as No. 1 Canadian wheat is of the very highest milling value, it will command a premium above its real single milling value.'

—'The Miller,' London, Eng. To maintain the present high standard of our milling wheats is therefore essential to continued success, and we should aim to produce twenty-five years from now at least as good a quality of wheat as we are growing to-day.

To succeed in this we must adopt and continue those practices that make for improved quality and increased yield in our crops. We cannot progress without this. Careless methods of cultivation and sowing, invariably result in an increase of weeds, depleted soil fertility and the mixing of varieties. Hence we see deterioration in the quality of crop instead of improvement.

VARIETIES.

Red Fife wheat has always been and still continues the standard variety of wheat for western conditions. It is a good yielder, produces a stiff strong straw that is not subject to rust, and produces a flour of the highest quality. This variety has greatly aided in giving Canadian hard wheat its enviable reputation on the markets of the world, and at present there is no variety that can be recommended above it for ordinary conditions. Under conditions where Red Fife will not mature before danger of frost, it is advisable to try some of the earlier ripening varieties originated by the experimental farms, and which have proved their adaptability to those conditions. Among those which have given good results in various districts may be mentioned Preston, Huron, Stanley and Percy. These varieties all compare favourably with Red Fife in yield per acre, and also produce a good yield and quality of flour. In some localities the practice of growing earlier ripening varieties is becoming very common regardless of whether they are of good milling quality. This will prove detrimental to the reputation of our wheat just in proportion to the extent to which it is followed.

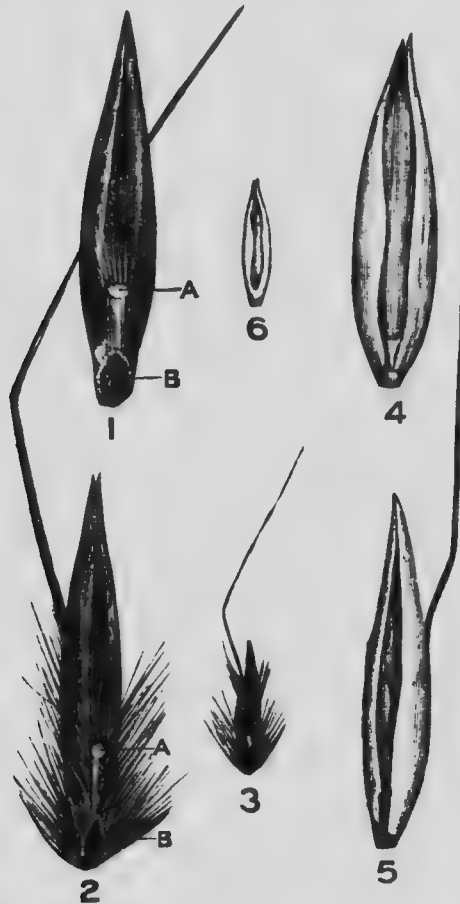
MIXED VARIETIES.

Uniformity in colour, size, and shape of kernels is one of the first essentials in a high grade of wheat. Different varieties of wheat present marked differences in the appearance of the kernels, and when several varieties are mixed together the resultant sample lacks uniformity. Usually also in a crop mixed in this way some varieties are ripe before others and we therefore find a much greater variation in appearance on this account. The early ripening varieties, (which often are bearded) in such a mixture continue to increase in proportion year after year, on account of shelling more readily and appearing as volunteer wheat the following season. Further, bearded soft strawed varieties of wheat are much more subject to the attacks of rust, and, becoming affected early, spread the disease rapidly to other plants surrounding them. The importance cannot, therefore, be too strongly urged of having, not only the best obtainable variety, but also of having it pure.

WEEDS.

In addition to the harm done by mixtures of this sort, weed seeds are every year the cause of incalculable direct loss. Weeds have been largely introduced through the medium of seed grain, and their rapid distribution through the farming areas is also largely through this medium. When they once get a foothold in a country such as this, where on the majority of farms no regular rotation is followed it becomes difficult to eradicate them. In many of the newer parts immunity from many of the worst weeds is still enjoyed, but not half appreciated. In such cases the utmost care should be taken to prevent their introduction. As an aid in accomplishing this it is important to know the weed seeds. The Wild Oats is one of the worst weeds that the Manitoba farmer has to combat at present, and it has been most commonly introduced

through seed grain. It is only necessary to know what the seed looks like to prevent its introduction from such a source, and with many of our other weeds the same is true. It is therefore highly important to be able to identify the seeds of our common weeds.



1. Form of Wild Oat (*Avena fatua*) (enlarged) as it usually occurs as an impurity in grain, the awn and hairy growth being broken off during the process of threshing.
2. Form of Wild Oat (enlarged) as it occurs in nature.
3. Form of Wild Oat (natural size).
- 4 and 5. Forms of the cultivated oat (*Avena sativa*) (enlarged).
6. Form of the cultivated oat (natural size).
- A. Point of attachment of 'bosom' oat. This characteristic in the Wild Oat is seldom present in the 'bosom' grain.
- B. A characteristic of all grains of the Wild Oat (*Avena fatua*).

SIZE OF SEED.

Various experiments have been conducted to determine the relative value of different sizes of seed. At the Indian Head Experimental Farm, Superintendent Angus Mackay, as the average of two years, reports a yield of 49 bushels and 40 lbs. from well cleaned wheat, and only 44 bushels and 30 lbs. from small wheat of the same

variety, a difference in favour of the well cleaned seed of over 5 bushels per acre. From well cleaned oats the average yield of two years was 101 bushels and 16 lbs., and from small oats 96 bushels and 11 lbs., a difference of 5 bushels in favour of the large seed. In a similar experiment at Guelph, Ont., Professor Zavitz obtained a difference in yield of 8 bushels per acre between heavy and light oats and of 5 bushels per acre in comparing the yields from heavy wheat with that from shrunken wheat. The results of Professor Zavitz are the average of ten years careful experimenting. These differences of a few bushels per acre may seem small until we consider what they amount to on a large farm, or on the total crop producing area of the North-west. An increase in yield of only one bushel per acre amounts in one year to upwards of 4,000,000 bushels of wheat in Manitoba and Saskatchewan, with a value approximating \$3,000,000. *Several times this increase could be derived simply by the sowing of seed that had all the small and shrunken grains cleaned out. The same process of cleaning also insures comparative freedom from weed seeds.*

The extent to which large plump grain will yield heavier than small grain of the same kind, will depend largely upon the season and the condition of the soil. With a favourable season for early growth, and a well prepared seed bed there will be a smaller difference in yields than where the conditions are less favourable for a thrifty well nourished growth. This, which has been found repeatedly and persistently to be the case is due simply to the fact that the plant from the large plump seed being stronger and possessed of more vigour, is better able to withstand adverse conditions than the more weakly plant from the small or shrunken seed.

RIPE AND IMMATURE SEED.

We have little definite information regarding the relative merits of ripe grain and immature grain for seeding purposes. In experimenting with winter wheat Zavitz found that 'seed taken from wheat which was allowed to become very ripe before it was cut produced a greater yield of grain and straw, and a heavier weight of grain per measured bushel than that produced from wheat which was cut at any one of four earlier stages of maturity, according to the average results of fourteen separate tests.' What other figures and facts at hand go to show is that for seeding purposes all classes of grain should be allowed to get thoroughly ripe before being cut. The impression that grain cut before maturing has a tendency to produce an earlier ripening strain has nothing to support it in fact. To get a strain that will ripen earlier, the more rational way would be to select every year that which matures first. Perfectly ripened seed gives a stronger early growth than immature seed.

FROZEN GRAIN FOR SEED.

There is frequently a temptation to sow grain that has been affected by frost. The value of such grain for seed depends entirely upon the degree of the injury. Not infrequently a frost will rattle the bran of wheat of good quality when in stook; as a rule the vitality suffers no injury and the seeding value is not affected. When, however, a frost occurs before the grain has reached maturity the vitality is often seriously impaired, and care is necessary to prevent a disappointing stand. The oat germ is more delicate than that of wheat, and is more likely to be injured by frost. When there is any likelihood that oats have been exposed to frost before being thoroughly ripe, they should be carefully tested before being sown, to determine their value. Wheat shrunken by being frozen when immature should never be sown when good seed can be secured. Such seed has all the disadvantages of small seed, and in addition has a weakened germ that will give a plant lacking strength and vigour. The extent to which this will affect the yield of the resulting crop will depend to a certain extent upon the weather conditions.

SEED FROM A RUSTED CROP.

While we have had only one serious visitation of rust in the wheat growing sections of the west, in all probability it will not be the last. In view of this, and the serious effects of rust on grain crops a few words on rusted seed may not be out of place.

It is now pretty generally understood that rust, (*Puccinia Graminis*), is a fungus disease that develops and lives inside the plant, extracting nourishment from it, checking its normal development. The reddish or black streaks or spots seen on the leaves or stems consist of numberless spores by which the disease reproduces itself. The seeds produced by plants badly affected by rust are shrivelled to a greater or less extent; frequently they are less than half the normal weight. Contrary to what might be expected, such shrivelled seed seldom fails to germinate. But we have already shown that to germinate life is only the beginning of the seed's function, and this being the case, it is quite apparent why seed from a rusted crop does not give satisfactory results. Seed from a plant badly affected by rust is analogous to immature, shrunk seed—it is light in weight, the germ is often weak, and the amount of starch stored up to feed the germ is small.

Carefully conducted experiments by the writer have shown conclusively that plants from seeds shrivelled by rust do not possess the vigour of plants grown from normal seeds, nor can they withstand adverse conditions, such as frost or backward weather nearly so well.

With grain, part of which is from a rusted crop, a good sample for sowing can be obtained by a thorough screening to remove all inferior, shrunk seed. In making such a separation, a start is also being made toward securing a strain of wheat less subject to the attacks of rust. To accomplish much in this direction, however, it is necessary that a selection be made of individual plants that show less liability to disease attacks than others under the same, or similar, conditions. In Australia, where rust is more prevalent than in this country, and where disease resistant strains are therefore of more importance, a fair degree of success has rewarded persistent effort in selecting strains less subject to rust.

THE GROWING OF SEED.

Those phases of the question that we have been dealing with are mainly those that would be taken into consideration in the purchase of seed. But only a very small percentage of the seed used in this country is purchased; by far the larger part is grown on the farm. The purchase of seed is usually confined to comparatively small quantities, an acreage large enough to furnish all the seed required the following year. In growing seed grain there are important points to be borne in mind.

SEED AND SOIL.

A very intimate relation exists between the soil and the quality of seed produced. To grow a plump and vigorous seed necessitates, in the first place, a soil capable of producing a healthy vigorous plant growth. A soil depleted in fertility by continued cropping produces a weak irregular growth, and it is not able to meet the demands made upon it by a heavy feeding crop. From such soil, therefore, we get seed that is lacking in vigour and uniformity. It is a recognized fact that grain deteriorates in quality if grown under unfavourable soil conditions. When carefully grown on fertile well cultivated soil, they frequently become vastly improved in quality and producing capacity. While the cereals are not so amenable to such treatment as some other crops, it is a fact that favourable conditions of growth maintain and improve good qualities in grain crops, while with poor conditions the reverse is the case. Excessively thick seeding is another cause for decreasing vigour in a crop, while crowd-

ing with weeds has a similar effect. The effects become more apparent when any of the unfavourable conditions of growth are continued for a number of seasons. This is shown very clearly by the results of an experiment conducted by Professor Zavitz in the continual selection of Joannette oats, a prolific black variety. For twelve years in succession an experiment was conducted in breeding oats by means of selection of seed. The selections were large, plump, well developed seed, and a light weight, light coloured, seed. The selection made each year was from the product of the selected seed of the previous year. An equal number of grains was used on each plot each year. *In the crop produced in 1904, the large plump seed yielded 94.1 bushels, weighing 34.5 lbs. per bushel, and the light seed 68 bushels, weighing 24 lbs. to the bushel.* The crop grown from the large plump seed required only 1,390 grains to weigh an ounce, while the crop from the light seed required 2,095 grains. The results of this experiment show conclusively that oats will degenerate if one of the conditions of successful growth, viz., plump, vigorous seed, be absent.

The lack of good soil conditions again, for a number of years, is sufficient in itself to account for marked deterioration in quality of grain. Under such conditions the functions of growth are performed with comparative difficulty and the resultant plant is less vigorous. The amount of crop depends directly upon the amount of plant food that can be obtained from the soil and assimilated. Certain varieties are capable of obtaining more plant food from the soil under certain conditions than are others, and therefore produce more abundant crops. It must therefore be borne in mind that to get the best results from improved varieties and strains, the soil requires to be in such condition as to render available to the crop a larger amount of plant food than when an ordinary variety is to be grown. The practice of growing seed on new land, or land in a good state of cultivation is therefore a most commendable one to follow. New land has the additional advantage of being free from noxious weeds. A soil that is exhausted by frequent cropping should not be used for the production of seed, even though the sample produced may appear acceptable. It lacks those qualities which go farthest to make seed valuable.

As a successful crop of seed grain depends largely upon the quality and condition of the soil upon which it is grown, the most suitable soil should be chosen. From ten to forty acres is sufficient to produce the seed required by the average farmer, and for the production of seed, this should be the best land on the farm. It should be seeded as soon as it can be got in good physical condition, with the best seed available. This involves little or no additional expense and always gives good returns, as the crop produced is more uniform and ripens earlier.

THE AMOUNT OF SEED PER ACRE.

This depends upon various considerations, viz., time of sowing, variety, nature and condition of soil, latitude, and kind of seed. With wheat, it varies from one to two bushels per acre, with oats and barley, from one and a half to two and a half bushels per acre. As a general rule, grain for seed should be sown sufficiently thin to allow the plants ample room for perfect development, bearing in mind that thinly seeded grain stools or tillers readily and therefore ripens more slowly than grain sown more thickly. The later the date of sowing the more seed per acre is required to insure ripening. Excessively rich land, or new land, frequently requires more than the average amount of seed per acre, as the available fertility tends to promote a luxuriant and late growth. Different varieties of grain differ materially in size of kernel and the quantity sown per acre requires to be regulated accordingly, the varieties with a small average kernel requiring somewhat less in bushels per acre than those with a larger kernel.

STACKING VERSUS STOOK THRESHING.

There are various points to be taken into consideration in deciding upon whether to stack or thresh from the stook. In growing seed the plan to follow is the one

which will most economically save the grain without weathering it, and with as little risk as possible. Grain badly weathered lacks the vitality of that properly saved. There is too much at stake to run any unnecessary risks, and care should be taken that the grain is perfectly dry before stacking or threshing. Dry storage is equally important, as any dampness whatever has a most injurious effect on the vitality of the seed.

CLEANING.

Figures have already been given to show that large seed will give a greater yield than small seed of the same kind, and that nothing should be sown but large plump seed. Care in cleaning always pays, and the more thoroughly small seed is cleaned out, the better are the results obtained. All grain for seed should be cleaned at least twice. A cleaning machine is to be preferred which has the cleaning action of both a current of air, and screens. Not infrequently large, light seeds are thus eliminated that would be sown if only screens were used.

CHANGING SEED.

Grain that has been grown under the conditions favourable to a healthy vigorous growth, does not deteriorate in quality and may be grown indefinitely on the same farm. When properly cared for it improves in quality and becomes more adapted to the conditions under which it is grown. The changing of seed which is so frequently advocated as a means of improving yields and quality of grain often gives very unsatisfactory results, and is not a practice that, in itself, leads to any permanent improvement. On the contrary, it is a fertile source for the introduction of weeds, and in that respect is a most iniquitous practice. A change of seed is advisable, and is productive of good results when a better quality of seed is obtained. When conditions are such that a crop can be grown to a perfect degree of development there is no excuse for changing seed. If, however, the conditions obtaining on a neighbouring farm are those under which a certain crop makes a more satisfactory growth, it is good policy to secure seed grown under such conditions.

HAND SELECTION OF SEED.

Instead of changing seed with the object of keeping up and improving the yield and quality, an intelligent selection of seed from year to year is recommended. Any careful observer will have noticed that different plants of the same variety differ in the size and number of heads they produce, and in their yield of grain. This is due sometimes to their being under slightly different conditions, one plant having a greater food supply than another, and to the difference in their inherent power to produce. Some plants are capable of yielding 20 per cent more than others under the same conditions, and we should aim to produce strains from the plants which are capable of a uniformly high yield. To a certain extent this has been done successfully with all kinds of grain crops, and the field for further improvement is still unlimited. An increased power to yield only one bushel more per acre, which is a small gain, amounts, in one season, with the present crop acreage in Manitoba, Saskatchewan and Alberta, to an aggregate of about 6,000,000 bushels increased production of grain. There are strains of the standard varieties that differ widely in their capacity to yield, and this is due largely to the system of growing and selection that has been followed from year to year. Some such strains have a pedigree just as truly as have many of the strains of live stock. But just as families and strains of the same breed of live stock differ in value according to the conditions under which they are produced, the skill of the breeder, and his chief object in view; so do strains of varieties of grains differ according to the skill of the operator, the conditions under which he worked, and the type towards which he

selected. The importance of having a type firmly fixed and constantly in mind cannot, therefore, be too strongly emphasized where permanent benefit is sought.*

On account of the skill, the time, and the labour involved in the work of improving crops by hand selection, it is a system that cannot profitably be followed by every farmer. Few men have an aptitude for such work, and some of these are so situated that a lack of labour precludes the possibility of their pursuing it successfully. This work can most satisfactorily and cheaply be done by those making a specialty of it. We find a comparatively few breeders and improvers of live stock but their work is beneficial to all other farmers and a ready market at remunerative prices is found for pure bred stock. In the improvement of grains we will get the best results where somewhat similar conditions obtain; where one farmer on a clean, well cultivated farm can supply twenty or thirty others with improved seed, at a reasonable advance in price over the market to pay for the additional cost in production.

TREATING FOR SMUT.

Smut is a fungus disease which attacks the different cereals more or less every year, with the frequent result that the yield is reduced, the market value lessened, and considerable loss thus incurred. The disease, which is reproduced by spores, attacks the plants when they are only a few days old, through the spores being attached to the seed. Various remedies have been discovered, and as they are inexpensive, it is advisable, every year, to guard against the effect of this disease by treating the seed. To prevent smut on wheat, bluestone (copper sulphate) has been found to answer admirably, in that it is easily applied and effectual in destroying the spores. The best results are got by immersing the wheat for a few minutes in a solution of bluestone, using one pound to from five to ten bushels of grain according to how badly it is affected. Sprinkling, if thoroughly done, is quite as efficacious as dipping, if care be taken that every grain is wet.

To prevent smut on oats and barley, formalin, (a 40 per cent solution of formaldehyde) gives best results. One pound of formalin is sufficient for fifty bushels of seed, except where much smut is present, when rather more should be used. With formalin, as with bluestone, soaking will usually give best results.

In all cases grain should be sown as soon as it can be dried after treatment. When sown immediately no damage results from the effects of the solution of the germ. If, however, it is allowed to stand for any considerable length of time after drying, a percentage of the grain will not grow; the amount varying with the length of time before sowing, and the strength of the solution.

TESTING SEEDS.

The testing of seeds for vitality has not received the attention it merits at the hands of those to whom it is of the greatest benefit. No matter what other good qualities a seed may have, if it does not contain a living germ it fails utterly in its purpose. No amount of experience in judging from external appearances can enable one to say definitely whether the germ of a seed is living or dead; it can be determined accurately only by putting it under conditions that are favourable for growth. Poor germinating capacity may be due to several causes. When a seed is fresh, the germ usually starts to grow as soon as the conditions necessary for growth, viz., a sufficient supply of moisture, heat and air are supplied. But as they get older, they gradually lose their ability to grow and finally die completely. The length of time that they retain vitality varies with different kinds of seeds and depends upon the manner in which they are preserved, and their condition when stored. Cereal seeds gradually lose their vitality after the second year, and when ten years old will usually fail to

* Further information regarding the selection of seed, and the registering of selected seed may be obtained from the secretary of the Canadian Seed Growers' Association, Ottawa, Ont.

germinate. A moist or musty condition in the store room is fatal to the vitality of the germ. Frost, injury during threshing, treatment with chemicals, all have an effect on the vitality of seeds. Where there is any doubt as to the vitality, it should be tested before sowing. To make a test of cereal seeds, one hundred seeds are required for a single test, and these should be selected to secure a representative sample. They should be put half an inch, or one inch deep in ordinary soil, and kept damp, and at the temperature of an ordinary living room. All the seeds which have a living germ should germinate under these conditions, and send up a leaf blade. After ten or twelve days the number of plants may be counted, and the value of the seed thus ascertained. If soil is not available, the seeds may be placed between layers of damp flannel or blotting paper, in a dinner plate with another plate inverted over this to keep in the moisture. The number of seeds which germinate may be counted from day to day. A good sample of seeds should not only have a large number of seeds capable of growing, but they should start quickly to grow and send out strong sprouts. Seeds which lie several days before sprouting are not as desirable as those which germinate sooner. A rapid uniform growth of at least 90 per cent is required in a first class sample of seed from any of the grains.

SUMMARY.

1. A good beginning is essential. The seed is the starting point of all successful crops. This is one of the few factors in crop growth that is controllable.
2. Grow only good milking varieties, pure and clean.
3. Grow your own seed. Changing seed is poor policy. Avoid the danger of introducing weeds. Change only when a *better* quality of *clean* seed is obtainable.
4. Good cultivation and productive soil are essentials in the growing of the best seed. Set apart a few acres of the cleanest and best land every year on which to grow seed. Sow as early as the land is fit. Allow it to mature perfectly. Thresh and store when thoroughly dry.
5. All seed should be thoroughly cleaned to remove weed seeds and all small grains. Once through a mill may not be enough.
6. Hand selection is a good way to keep varieties pure, to improve quality, and increase yield.
7. Smut can be prevented by treating the seed.
8. Prove the vitality of your seed by testing.

